U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Base from U.S. Geological Survey, 1955, 1:24 000,
Handies Peak, Howardsville, Ironton,
Ophir, Silverton, and Snowdon Peak.
Projection: Universal Transverse Mercator, zone 13.
10,000-foot grid based on Colorado
coordinate system, south zone.
1927 North American datum

SCALE 1:48 000

CONTOUR INTERVAL 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

GRADIENT DETERMINATIONS FOR THE ANIMAS RIVER AND ITS MAJOR HEADWATER TRIBUTARIES, ANIMAS RIVER WATERSHED, LA PLATA AND SAN JUAN COUNTIES, COLORADO

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DIGITAL DATA SERIES 71
PLATE 11

Slope and Stream Gradient
(gradients in parentheses reported in m/km)

Slope less than 0.015

Slope 0.015–0.024

Slope 0.025–0.035

Slope greater than 0.035

Values adjacent to a stream reach are the approximate slope and gradient (in parentheses) for the entire reach. Slope and gradients calculated are determined from the starting and ending points only along each reach. Black lines are used to bracket stream reaches.

Click on a stream reach to view a graph that shows the gradient profile along the length of the reach.

GRADIENT CALCULATION METHOD

Gradients were calculated using U.S. Geological Survey 10-m Digital Elevation Models (DEM) and ARCINFO GRID software functions for stream drainage network delineation.

The following sequence of DEM processing steps was used to create a stream grid that corresponds to the reaches along which surficial deposits were mapped as part of this project. GRID functions are in bold italic.

(1) Calculate flow direction grid: flow_grid = FLOWDIRECTION (original_dem)

(2) Identify sinks: sink_grid = SINK (flow_grid)

(3) Identify area contributing to sinks: sinkarea = WATERSHED (flow_grid, sink_grid)

(4) Calculate minimum and maximum elevations in the watershed for each sink:
sinkmin = ZONALMIN (sinkarea, original_dem)
sinkmax = ZONALFILL (sinkarea, original_dem)

(5) Calculate the maximum sink depth: sinkdepth = sinkmax - sinkmin

(6) Fill sinks in original_dem to the level determined in step 5 and create a DEM with no sinks and a new flow direction grid based on the the DEM with no sinks. The GRID command to do this is as follows:
FILL < original_dem> <out_grid> SINK (z-factor determined in step 5) new_flow_grid

(7) The Flowaccumulation function was used to create a grid depicting the accumulated flow relative to each grid cell:
fa_grid = FLOWACCUMULATION (new_flow_grid)

(8) The CON function was used to create a network of drainages by assigning "one" to all cells that accumulated flow from more than 100 cells:
streamnet = CON (fa_grid > 100, 1)

(9) A vector drainage coverage was then created using the STREAMLINE function

(10) All arcs other than those of interest were then deleted, that is other than those along where surficial deposit mapping was accomplished (see plates 1–10) using ARCEDIT; pseudonodes were removed; and the FLIP command was used to make the "to" node down river from the "from" node.

(11) The SURFACEPROFILE command, utilizing the ARCTIN Module, was used to generate an INFO file that had the distance and elevation information necessary to calculate the gradient for each reach.

ANALYTICAL UNCERTAINTY

The source DEM data used for the gradient calculations has a root mean square (RMSE) elevation error of about 7 m. Therefore, gradient determinations are approximate.

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